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(71) Applicant(s)
Psion Connect Ltd
(Incorporated in the United Kingdom)
Presley Way, Crownhill, MILTON KEYNES, MK8 0EF, United Kingdom

(72) Inventor(s)
Lionel Wolovitz

(74) Agent and/or Address for Service
Origin Limited
52 Muswell Hill Road, LONDON, N10 3JR, United Kingdom

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Online: Internet, EPODOC, PAJ, WPI

(54) Abstract Title
Retractable antenna for PC etc

(57) A PC Card 2 includes a slide-out antenna PCB platform (9, fig 1) on which is also mounted an analogue RF amplifier and at least one component, such as a baseband processor, D/A converter, filter, modulator or demodulator or coder or decoder, which can perform digital processes. Placing the component(s) which perform(s) digital processes next to the antenna removes the need for a flexible and expensive connection which would be required if for example, the platform included solely HF components. When the platform partly slides out of the PC Card casing, it automatically turns the device on; sliding the platform back in automatically turns the device off. The platform can also be fully removed from the PC Card for replacement with an upgrade. The PC card is itself removeable and replaceable.

Application to mobile telephones is also possible.

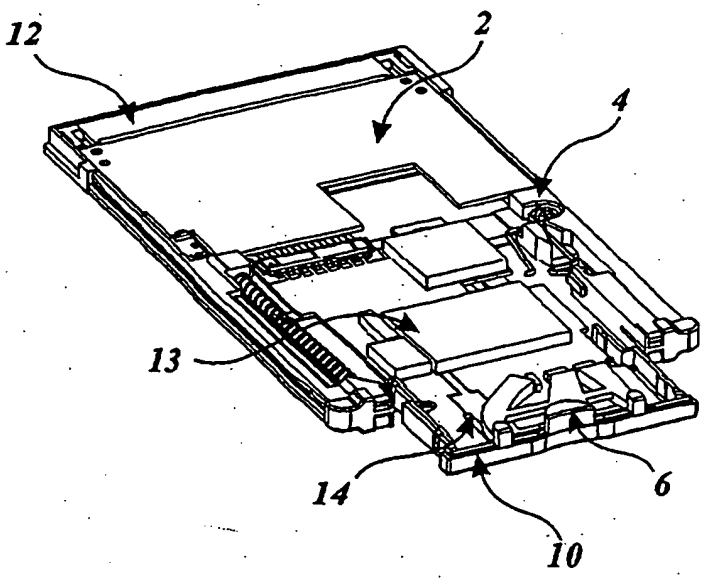

Fig. 2

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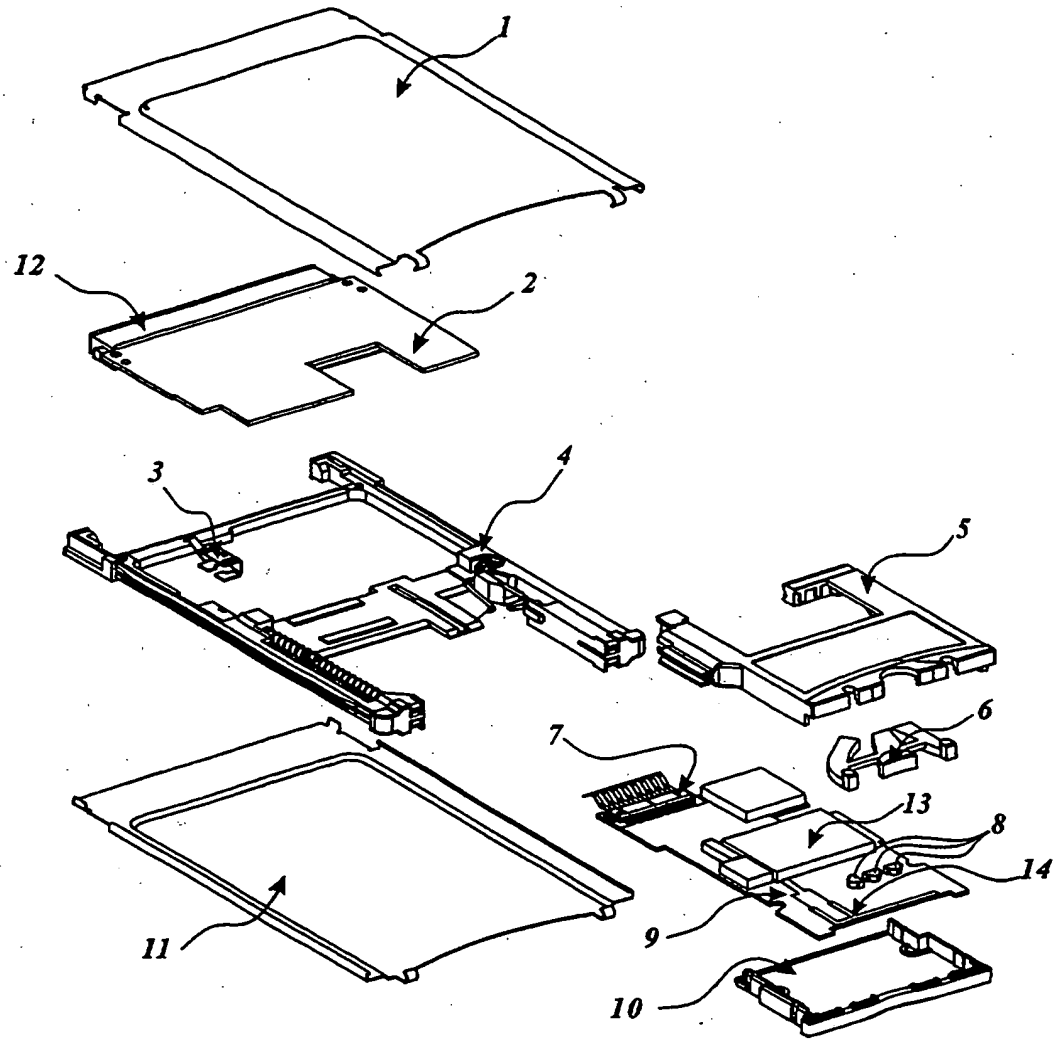


Fig. 1

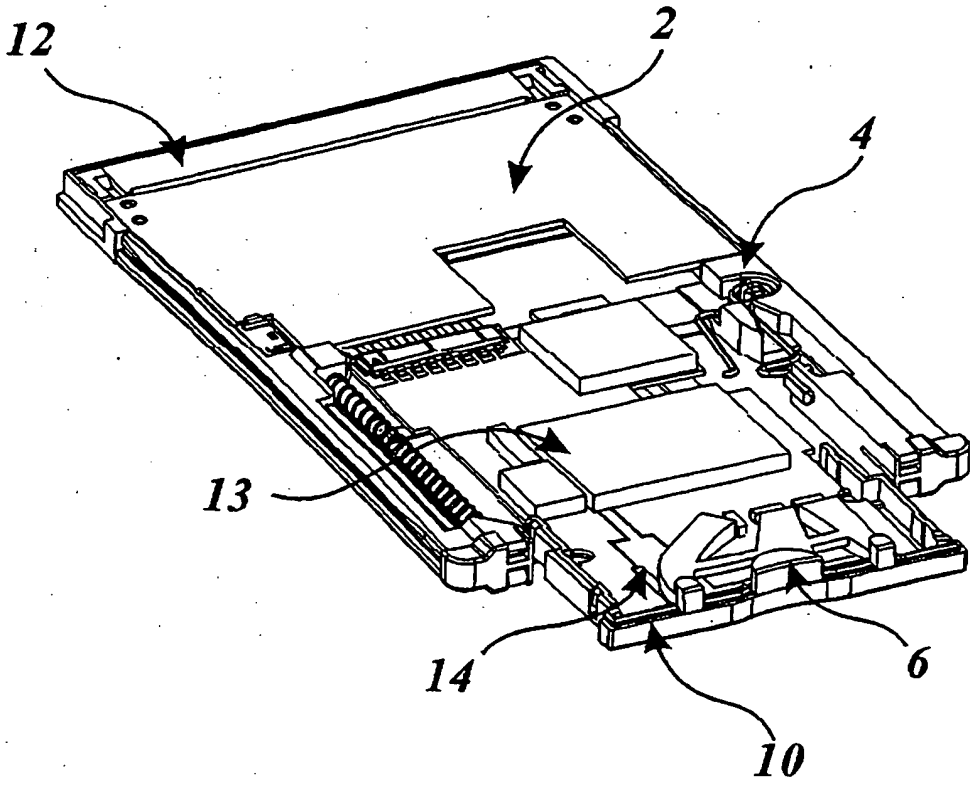


Fig. 2

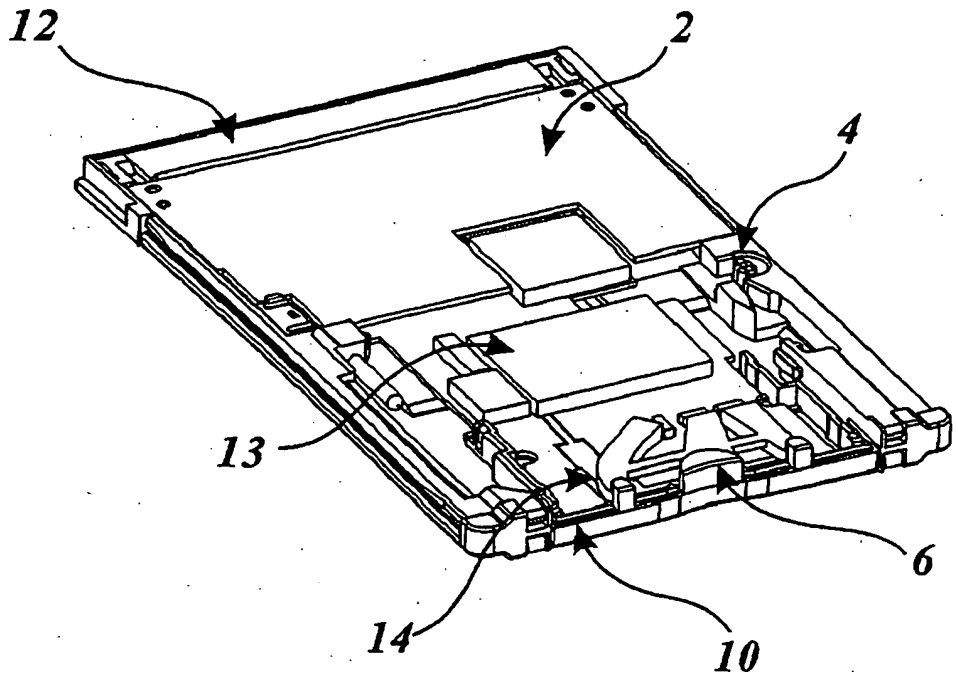


Fig. 3

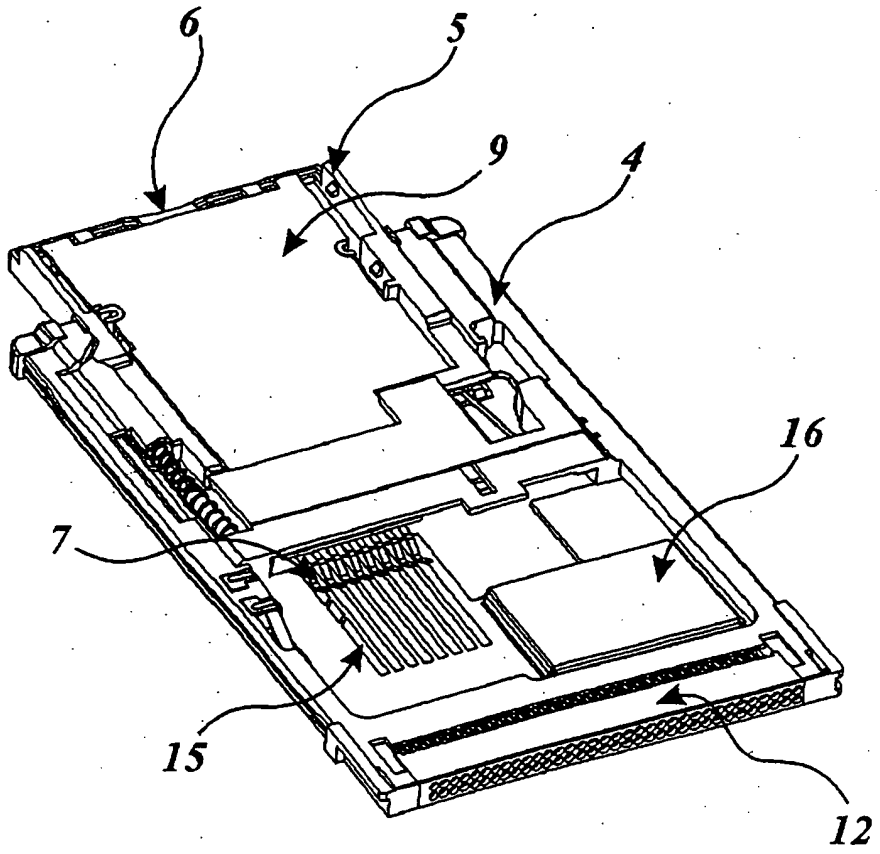


Fig. 4

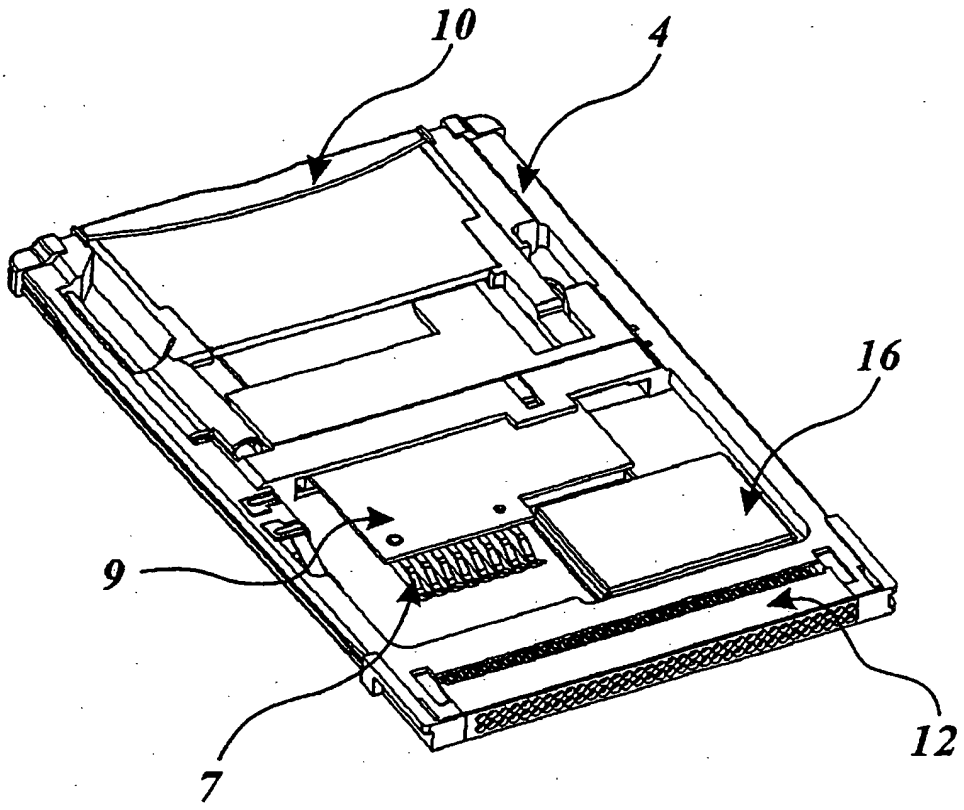


Fig. 5

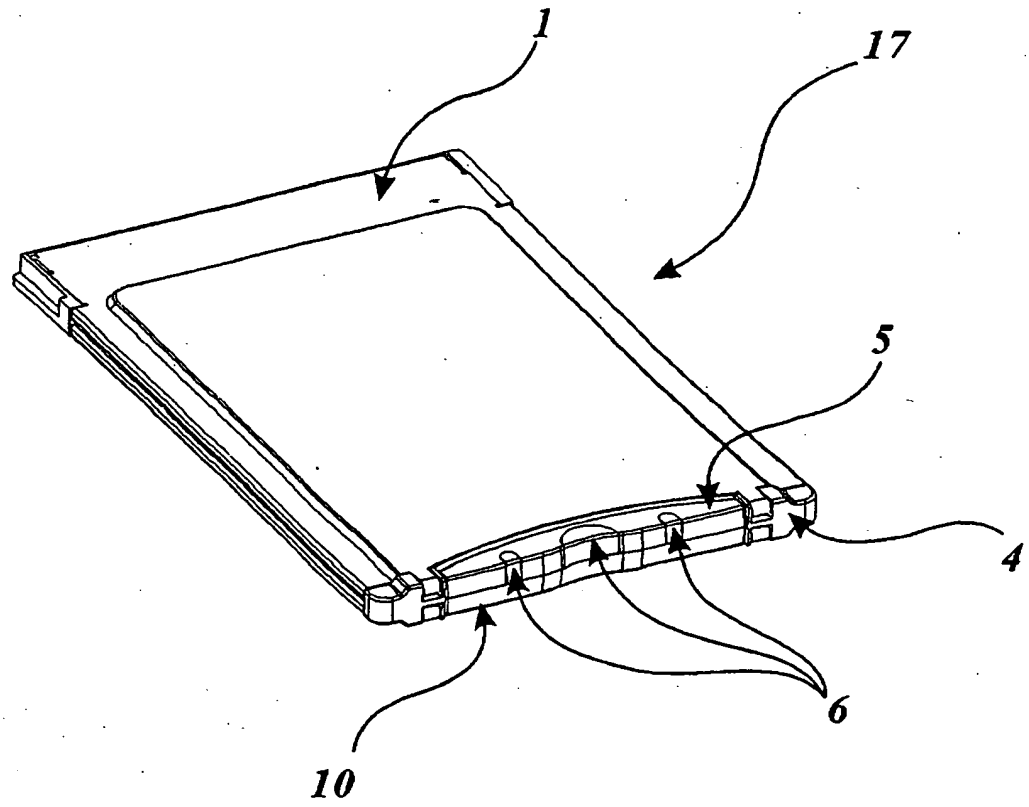


Fig. 6

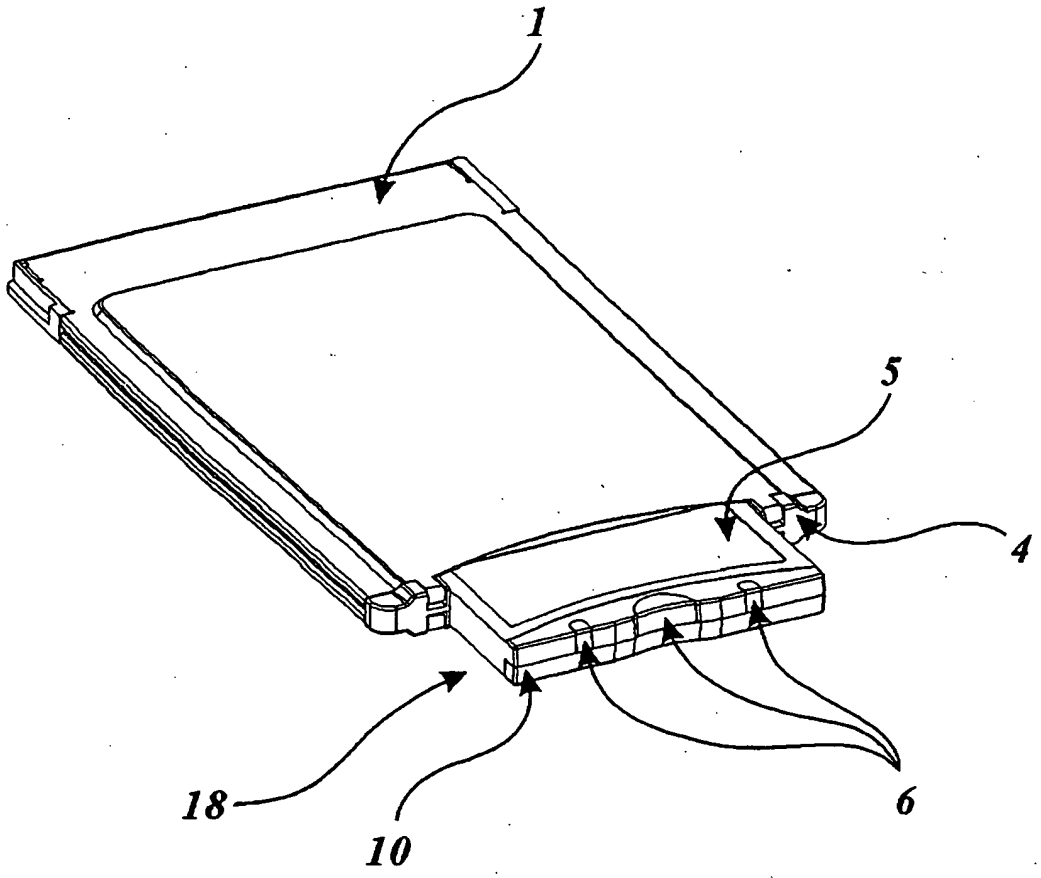


Fig. 7

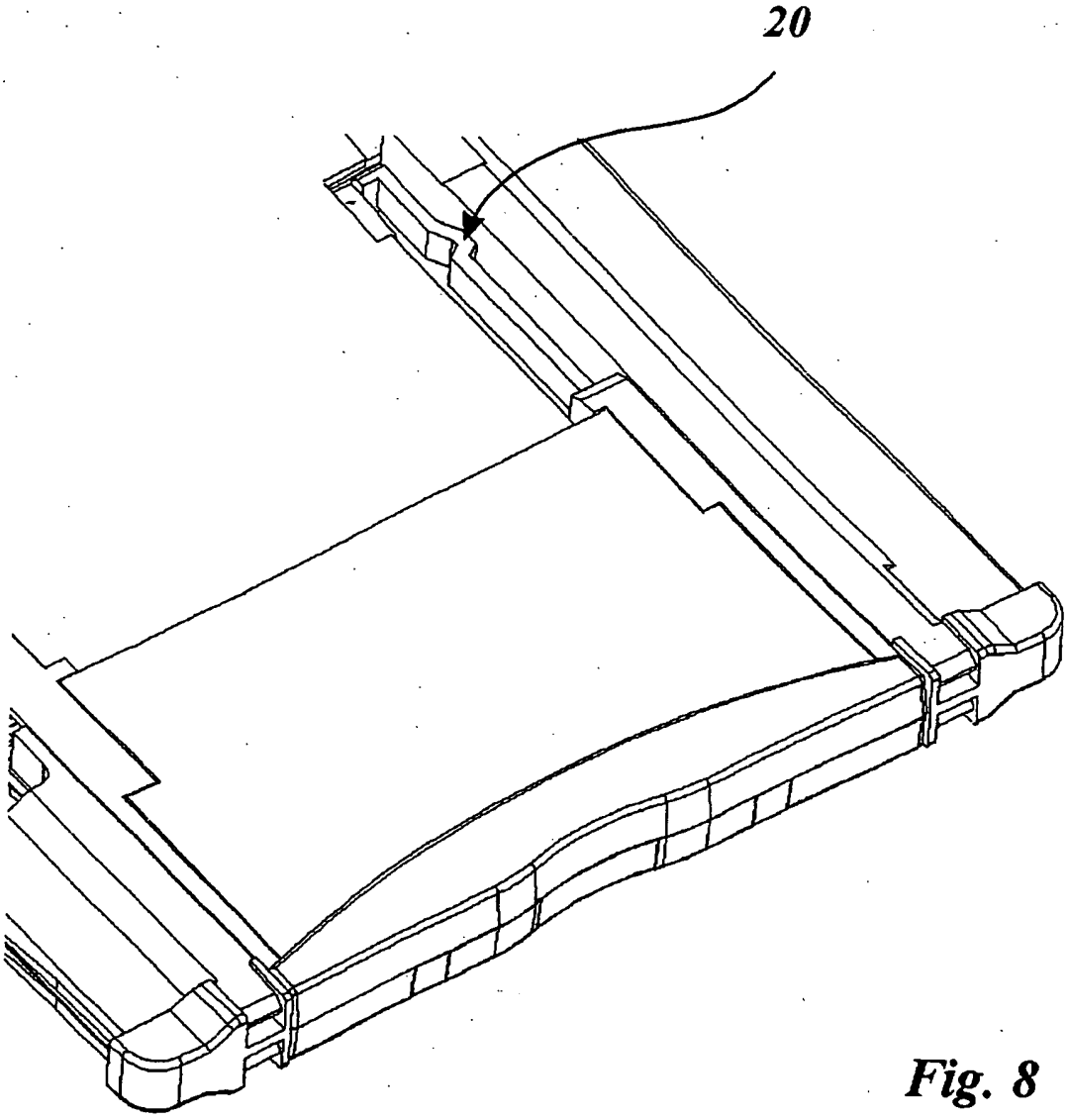


Fig. 8

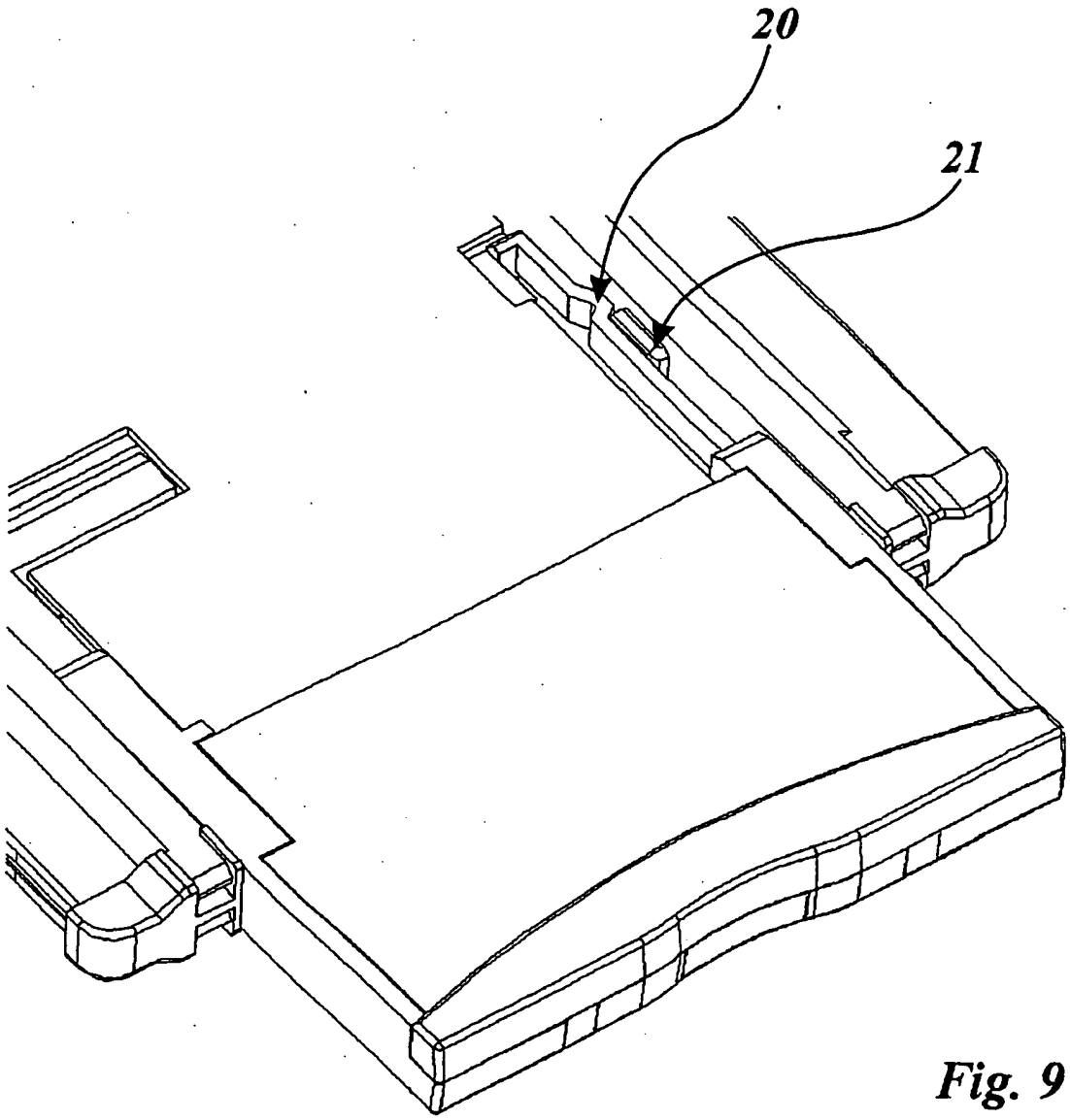


Fig. 9

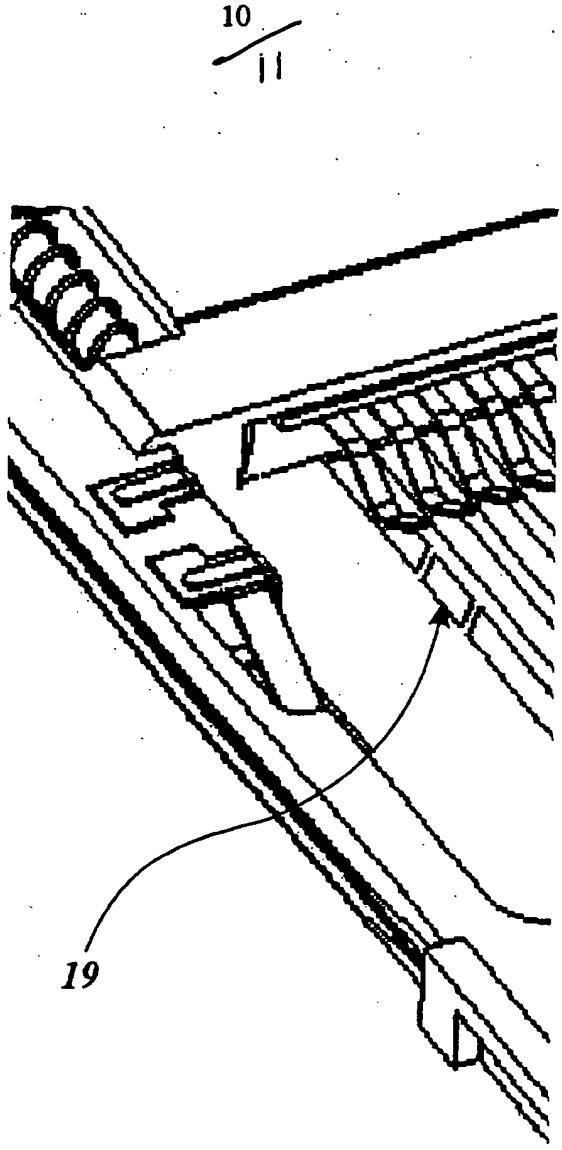
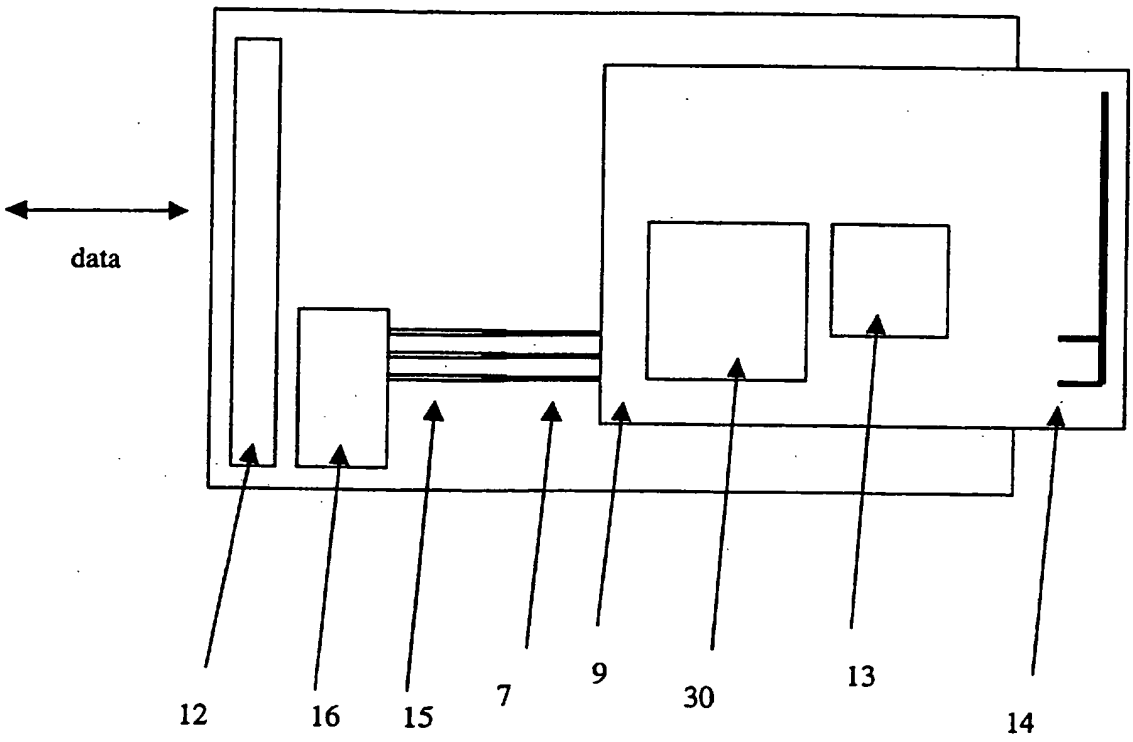


Fig 10

Figure 11



Removable Wireless Device

Field of the Invention

This invention relates to a removable wireless device which can be readily inserted into and entirely removed from a computing device. The term 'wireless device' used in this specification refers to any electronic device which includes a wireless reception and/or transmission capability, irrespective of whether or not other (e.g. wire based) forms of communications capabilities are also supported. Applicable wireless formats include, without limitation, the Bluetooth (RMV) and 802.11 short range radio standards.

Prior Art Description

Providing a conventional notebook computer with wireless communications capabilities can be done in several ways, including for example, the use of a GSM PC Card inserted into the PC Card bay of the notebook computer. One design constraint affecting wireless devices is that an antenna generally has to protrude significantly from the wireless device casing, since that casing is usually metal and would therefore screen incoming and outgoing radiation. Hence, an antenna formed on a PC Card also has to extend significantly from the metal casing of the PC Card when in use.

This has led to three kinds of commercially manufactured antenna designs for wireless devices: first, antennas which are permanently connected to their associated radio receiver/transmitter hardware but are hinged and can fold out of a casing for use. An example of this would be a PC Card with a small hinged antenna which is hinged flush with the top of the PC Card when not in use, so that the antenna extends only slightly from the casing of the notebook computer into which the PC Card is inserted. FM radios typically

also use a hinged, telescopically extensible antenna. When wireless communications are required, the antenna can be hinged outwards and extended as required.

A second kind of design is an antenna which is removable when not in use but which can be readily connected for use. An example would be a clip-on antenna for a PC Card offering wireless capabilities: a small antenna connects to the PC Card body via a high quality electrical connector.

The third kind of antenna is the permanently fixed antenna, for example the stub antenna as commonly found on mobile telephones.

These approaches all have disadvantages: the hinges of hinged antenna can often be readily damaged; removable antenna can be too readily lost and permanently fixed antennas are susceptible to damage. Another disadvantage with conventional designs is that the electrical connectors leading from the antenna to the radio receiver/transmitter circuitry have to carry radio frequency signals with high integrity and are therefore relatively expensive, high quality components.

One solution which partly addresses some of these drawbacks is to include the antenna on a platform which can slide out of a PC Card casing. Because the antenna is mounted on a retractable platform, it is both robust when extracted, cannot be lost and may also be fully retractable within the casing when not in use. Reference may be made to US 5918163 and EP 0936694. In these designs, the circuitry which processes digital signals (e.g. including the baseband processor) is not included on the platform which can slide out, but is instead mounted on a PCB fixed inside the PC Card casing. Hence, this art explicitly teaches placing analogue components alone on the slide out platform.

Reference may also be made to US 5557288, which shows an antenna with associated analogue circuitry mounted on a platform which can be slid out of a portable computer casing. The antenna platform disclosed in this patent is not however entirely removable as such from the casing: instead it can merely slide out a short distance. This art therefore relates not to a PC Card type system which can readily be slotted into and withdrawn from a standard bay, but instead to a permanent, fixed structure in a computer. This art also explicitly teaches placing only analogue circuitry on the slide out platform, although the precise function performed by this circuitry is not made explicit.

The requirement to provide wireless communications capabilities to electronic devices will become increasingly important as wireless communications becomes ever more pervasive. For example, recent developments in technology, such as the 802.11 and Bluetooth (RTM) standards for short range radio, offer the possibility of connecting devices such as PDAs and laptop computers into Pico nets or local areas networks; Bluetooth (RTM) and 802.11 enabled computers and peripherals will likely become popular wireless devices, able to transmit and receive wireless data with other compatible equipment, such as other computers and peripherals. Antennas and radio transceivers which can work with 802.11 and Bluetooth (RTM) signals require high integrity electrical connections, so that the conventional solutions would be particularly expensive because of the required high quality of the components.

Summary of the Present Invention

In a first aspect of the invention, there is provided a removable wireless device which is adapted to be insertable and fully removable from a computing device, the wireless device comprising:

(i) an antenna;

(ii) an analogue radio amplifier connected to the antenna;

(iii) a platform on which the antenna and radio amplifier are mounted, the platform being retractable into a casing of the device when the antenna is not in use and extendable out of the casing to enable the antenna to operate effectively;

wherein the device further comprises one or more components, mounted on the platform, which perform a digital process.

By placing at least some of the circuitry which applies digital processes on the movable platform itself, significant manufacturing advantages can be obtained. For example, where the components perform digital processes such as signal detection or digital demodulation, then placing the components on a platform shared with the analogue radio amplifier (and generally also the radio transceiver) leads to the expensive co-axial connections otherwise needed to bring a radio signal to a radio transceiver placed in the body of the PC Card being entirely eliminated. More generally, the component mounted on the platform may perform one or more of the following digital processes:

(i) D/A conversion;

(ii) Signal filtering;

(iii) Modulation or demodulation;

(iv) Channel coding or de-coding;

(v) Generating an analogue baseband signal;

(vi) Generating a digitised version of an analogue baseband signal.

The component may be a baseband processor and/or a radio transceiver.

The term 'computing device' used in this patent specification should be expansively construed to cover any form of data handling device, including without limitation a portable computer, desktop computer, communications device, mobile telephone, desktop phone, smart phone or communicator.

The platform may be a printed circuit board. The platform need not be a single unitary piece: the only requirement is for the part of the platform on which the antenna is attached to be fixed relative to the part of the platform on which the circuitry handling at least some digital signal processes is mounted. An advantage of mounting the antenna on a PCB shared with the related analogue transceiving circuitry and also at least some of the circuitry which can process or handle digital signals is that the required electrical connections can for example be a simple rigid connection such as a connection printed directly onto the printed circuit board.

The baseband processor is typically connected via a data connector interface to the computing device via cheap and robust fixed tracks. No high integrity cabling needed to carry a wireless signal is therefore required at all in such an implementation. In one implementation, several chips (typically a physical interface, a baseband processor, a MAC (Media Access Controller) and RAM are all mounted on the retractable platform. Simple and relatively cheap fixed tracks or ribbon connectors then connect the MAC to a standard 68 way PCMCIA connector at the rear face of the card.

In a preferred embodiment, the platform slides within a PC Card casing conforming for example to a PCMCIA standard. The term 'PC Card' as used in this specification refers to any kind of small computer peripheral which can be placed into electrical engagement with a computer to provide directly or indirectly additional resources or functions for that computer or enable another connected device to use resources or functions of that computer. It includes cards such as PCMCIA cards, and CompactFlash (CF) cards, which are widely used with many different kinds of computer and offer a vast range of functionality, including voice and data communications, and memory expansion. PC Cards conform to precise physical and performance constraints and typically slot into a standard sized bay in a computer host.

Since PCMCIA card slots are so common in notebook and laptop PCs, this is a particularly convenient implementation since it means that a fully functional wireless radio device, for example a wireless LAN 802.11 or Bluetooth (RM) device, can be fitted to a wide range of computing devices. Conventional wireless LAN antennas are somewhat delicate and readily broken, so that the robust solution offered by this embodiment is an attractive one.

The card may slide out under the force of a spring ejection mechanism, have a motorised ejector or be merely pulled out manually.

Further details of the invention are stated in the appended claims.

Brief Description of the Drawings

The invention will be described with reference to the accompanying drawings, in which:

Figure 1 is an exploded perspective view of a PC Card implementation of the present invention with a radio transceiver and baseband processor modules and an antenna mounted on a platform retractable within the PC Card;

Figure 2 is a perspective internal view of the PC Card implementation with the platform fully extended;

Figure 3 is a perspective internal view of the PC Card implementation with the platform fully retracted;

Figure 4 is a perspective internal view of the PC Card implementation with the platform extended and showing the components fixed within the PC Card casing;

Figure 5 is a perspective internal view of the PC Card implementation with the platform retracted and showing the components fixed within the PC Card casing;

Figure 6 is a perspective external view of the PC Card implementation with the platform extended;

Figure 7 is a perspective external view of the PC Card implementation with the platform extended;

Figure 8 is a perspective external view of part of the PC Card implementation showing a part which prevents the platform from being readily fully retracted;

Figure 9 is a perspective external view of part of the PC Card implementation showing a part which prevents the platform from being readily fully retracted;

Figure 10 is a perspective view of connector tracks used in the PC Card implementation;

Figure 11 is a schematic of the electronic components used in the PC Card.

Detailed Description

The detailed implementation shown in the attached figures is a PCMCIA format card which includes a 802.11 antenna, radio transceiver and baseband processor, all mounted on a platform which can slide in and out of the card casing. The card itself can be inserted into a standard PC Card bay in a laptop computer to give 802.11 standard short range radio connectivity for data transfer.

Referring now to **Figure 1**, the PC Card comprises a top metal cover **1** and a bottom metal cover **11**, which provide electromagnetic screening to the electrical components positioned within them. A plastic frame **4** sits between the two metal covers **1** and **11**; a fixed PCB **2** is positioned on frame **4** and includes at one end a standard PCMCIA 68 way connector **12**, which in use electrically connects the PC Card to the lap top computer (not shown). A grounding clip **3** is positioned on frame **4** such that when the PC Card is in use, it electrically

contacts a grounded portion of the PCB 2 and also the top and bottom metal covers 1 and 11, thereby grounding each of those covers 1 and 11.

A radio transceiver PCB 9 is a platform which is arranged to slide in and out of frame 4 approximately 10mm, as shown more clearly in Figures 2 and 3. Radio transceiver PCB 9 has mounted upon it a radio transceiver unit 13; an inverted F antenna 14 and three LEDS 8 which indicate the functioning of the PC Card. Radio transceiver unit 13 is a Bluetooth (RM) radio chip such as the BlueCore01 from Cambridge Silicon radio. Many other vendors also supply Bluetooth radio chips; further information can be found at the Bluetooth.com web site. The Bluetooth radio is a digital radio operating at 2.4GHz. Figures 2 and 3 show respectively the assembled PC Card with the top cover 1 removed and the combined antenna/radio transceiver platform 9 fully extended and fully retracted. As can be seen, with the platform 9 fully extended, antenna 14 fully protrudes from the card, clear of the shielding offered by the metal covers.

Additional signal processing components are also mounted on the radio transceiver PCB 9, including a baseband processor and RAM. In some implementations, a single component including several discrete chips (e.g. RF transceiver, Baseband and link manager) may be useful. The Bluemoon component from Infineon AG is one such example. A top radio cover 5 and bottom radio cover 10 is positioned around the end of the radio transceiver PCB 9 which in use may extend out of the PC Card.

Inverted F antenna 14 is a slim and cheap form of printed antenna and is therefore very suitable for a slim, low cost product such as a 802.11 or Bluetooth (RM) PC Card. Antenna 14 is positioned at the outer edge of the radio transceiver PCB 9 so that it extends substantially from the top and bottom metal covers 1 and 11 when the platform, i.e. the radio transceiver PCB 9, is fully extended, as shown in Figures 2 and 7. LEDS 8 need to be visible at the front face of the radio transceiver PCB 9 but cannot overlie the antenna 14 since they and

their leads would interfere with radio reception and transmission; LEDS 8 are therefore positioned back from the front face, but a light pipe 6 feeds light from them to the front face, as more clearly shown in Figures 2 and 3. LED(s) 8 are used in the antenna module to indicate the status or condition of the device, for example the received signal strength, link status, and data flow. The LEDs 8 can be modulated in intensity (for example the stronger the received signal, the brighter the LED), or on/off duty cycle (for example the stronger the received signal, the more rapidly the LED blinks, or is on for longer). The LEDs 8 can for example pulse on for a short period each time a specified amount of data is transmitted or received. The user may specify which status each LED indicates and the means by which this is indicated. A combination of LEDs or multi-colour LED can be used to indicate status, for example colour could be varied from red, through orange to green could be used to indicated signal strength from none, weak through to strong.

A sliding connector 7 comprising a comb of eight metal fingers is positioned on the rear of the radio transceiver PCB 9; sliding connector 7 transfers digital signals to and from the signal processing circuitry on radio transceiver PCB 9, to the connector tracks 15, which are formed on the fixed PCB 2, as more clearly shown in Figures 4 and 5.

Figure 4 shows the PC Card from the rear; the holes of the PCMCIA 68 way connector 12 are clearly visible; these mate with pins located within the PC Card bay of the laptop computer (not shown). A PCMCIA interface chip 16, mounted on fixed PCB 2, is connected to 68 way connector 12 and receives digital signals passing along printed connector tracks 15 (and vice versa). Connector tracks 15 are in turn electrically connected to the 8 way sliding connector 7, as noted above.

As the platform 9 slides out of the PC Card, the 8 way sliding connector 7 slides along connector tracks 15, maintaining electrical contact. Electrical power to the radio transceiver 13 and other components on platform 9 passes through connector tracks 8 and sliding

connector **7**. **Figure 10** shows the detail of one of the connector tracks **15** in more detail. A break **19** exists in one connector track; this enables a simple mechanism for sensing the position of the platform to be implemented as follows: different voltages are applied to the track **15** on one side of the break **19** as compared to the other side of the break **19**. The voltage picked up by the contacting comb of 8 way connector **7** will be different depending on which side of the break **19** it is positioned. Suitable signalling therefore enables the position of the platform **9** to be sensed so that when the platform is pulled out ready for operation, the PC Card is automatically switched on; when the platform is pushed back in, then the appropriate power down process is automatically initiated. This is useful for quick disabling as may be required, for example, on or when entering an aeroplane. The switch off is properly designed so that all appropriate switch off protocols are followed – e.g. remotely connected devices know that the device is being turned off in a controlled manner. One advantage of this approach is that it does not require any software application to switch on/ off the radio and the status of the radio is immediately visible to a user.

When the antenna is to be used, it can be readily extended by the user gently pushing the front face of the radio covers **5** and **10**. This causes a 1-way locking mechanism to be disengaged, allowing a spring mounted on frame **4** to push platform **9** out. Small stops on the platform **9** ensure that it is not extended too far. When the user wishes to turn the wireless device off, then the user simply pushes platform **9** back into the PC Card casing and 1-way locking mechanism engages again.

Upgradeability

It is generally desirable to make computer products alterable or upgradeable to allow for changes in the applicable technical standards, or to add new or enhanced features. These "upgrades" can sometimes be implemented by updating the program memory associated with the micro-processor implementing the standard (or protocols). In some devices the program memory consists of volatile RAM and is downloaded from a host computer each

time the device is used. In others it consists of non-volatile memory, for example flash memory. This memory may be updated from the host computer. Some communications products use program memory that does not facilitate upgrading, for example ROM (read-only memory).

A software upgrade may however sometimes be inapplicable. For example where radio circuitry designed for one standard is not able to conform to the different or higher data speed modulations of a new standard, then a product incorporating that radio circuitry can be rendered obsolete. Some limited forms of hardware upgradeability have been common in the computer field for many years; for example, RAM memory, hard drives and microprocessors can be swapped out and upgraded in many personal computers. However, engineering a product so that it is readily upgradeable can add significantly to the complexity of the product and hence its manufacturing cost. For many consumer electronics products, profit margins are already highly pressured, making it difficult to justify reducing the margins further by adding upgradeability features which may or may not be attractive to purchasers. The term 'upgraded component' denotes both a component with increased functionality and/or specification as well as a component with a merely different functionality and/or specification.

The present invention addresses this issue: When the slidable platform **9** is first mated into the PC Card frame **4** (typically during first manufacture or a user upgrade procedure), a simple sliding engagement is enough to cause an adequate electrical connection between connector comb **7** and connector tracks **15**. Slidable platform **9** can be entirely withdrawn without any damage to the PC Card or the slidable platform **9**. This is achieved as follows: a small spring feature **20** (shown in **Figure 8**) is present on the slidable platform **9**. Feature **20** normally engages stop feature **21** (shown in **Figure 9**), positioned on frame **4**, therefore preventing slidable platform **9** from being fully withdrawn from frame **4**. However, a more forceful pull can cause the spring feature **20** to be pushed to one side, allowing the slidable

platform **9** to be withdrawn past stop feature **21**. A slidable platform **9** with upgraded components (not shown) can then readily be slid into the frame **4**, automatically engaging the connector tracks **15** when sufficiently inserted.

Signal Processing walk through

Figure 11 shows a simplified schematic of the main electronic components. As noted above, digital data is passed into a PCMCIA 68 way interface **12**, controlled by PCMCIA interface **16**. Digital data passes along fixed connector tracks **15** and is picked up by a siding connector **7** which is fixed to slidable platform **9**. Slidable platform **9** has mounted on it a baseband processor **30** as well as a radio transceiver chip **13**, feeding an antenna **14**. The detailed operation of such a system will be appreciated by a skilled radio systems implementer and will therefore only be described in outline here. The typical transmit sequence is as follows: source digital data is received at the baseband processor from the laptop. At the baseband processor, the following functions are carried out: first, channel coding occurs. In this process, the source digital data is multiplexed with forward error correction and framing bits. The purpose is to add redundancy to the information content so that bit errors can be detected in the receiver. A channel bitstream is generated as a result of the channel coding process. Digital modulation then occurs; the channel bitstream is merged to the signal samples which will be transmitted over the 2.4GHz air link. In Bluetooth (RTM) the GFSK digital modulation process occurs. The resultant signal is pulse shape filtered and then converted to analogue in a D/A converter. The analogue signal is then upconverted to the required frequency range and amplified to the required transmit power. The amplified signal is then passed to the antenna for transmission. The reception process is in essence the inverse of the above process.

The kind of components used to perform the above sequence can vary from implementation to implementation. For example, a baseband processor can be used to perform all steps up to and including the D\A conversion, including link control and management functions, leaving the radio transceiver to perform solely the analogue signal processing functions of upconversion and amplification. In other implementations, the radio transceiver chip can itself perform significant digital signal processing tasks, such as modulation/demodulation; carry digital signals such as control logic signals (e.g. for controlling an amplifier); and perform digitally controlled power management tasks.

Claims

1. A removable wireless device (as hereinafter defined) which is adapted to be insertable and fully removable from a computing device (as hereinafter defined), the wireless device comprising:

(i) an antenna;

(ii) an analogue radio amplifier connected to the antenna ;

(iii) a platform on which the antenna and radio amplifier are mounted, the platform being retractable into a casing of the device when the antenna is not in use and extendable out of the casing to enable the antenna to operate effectively;

wherein the device further comprises one or more components, mounted on the platform, which perform a digital process.

2. The removable wireless device of Claim 1 in which a component mounted on the platform perform one or more of the following digital processes:

(i) D/A conversion;

(ii) Signal filtering;

(iii) Modulation or demodulation;

(iv) Channel coding or de-coding;

(v) generating an analogue baseband signal;

(vi) generating a digitised version of an analogue baseband signal.

3. The removable wireless device of Claim 2 in which one or more of the following components are mounted on the platform:

(i) a baseband processor;

(ii) a radio transceiver.

4. The removable wireless device of any preceding Claim in which the platform comprises a printed circuit board.

5. The removable wireless device of Claim 4 in which electrical connections between the antenna and the or each component mounted on the platform are printed directly onto the printed circuit board on which the components and the antenna are mounted.

6. The removable wireless device of any preceding Claim in which the antenna is printed directly onto the circuit board.

7. The removable wireless device of any preceding claim in which the platform slides within a PC Card casing.

8. The removable wireless device of any preceding Claim in which the platform may slide out under the force of a spring ejection mechanism, the force of a motorised ejector or be capable of being extracted manually.

9. The removable wireless device of any preceding Claim in which the device further comprises a sensor which detects the position of the platform and automatically switches the wireless device on if the platform is extended beyond a first position and automatically switches the wireless device off if the platform is retracted beyond a second position.

10. The removable wireless device of Claim 9 in which the sensor comprises a voltage sensing arrangement in which the voltage applied to a part of the platform varies depending on its position and the applied voltage can be measured to determine the position of the platform.

11. The removable wireless device as claimed in any preceding Claim further including LEDs which are controlled to light up indicating the status or condition of the Card.

12. The removable wireless device of Claim 11 in which the LEDs are mounted distant from the antenna in order to minimise interference with the antenna and at least one light pipe carries light from the LEDS.

13. The removable wireless device of any preceding Claim in which the platform is fully removable from the device to allow a new platform to be inserted into the device.

14. The removable wireless device of Claim 13 in which the removable platform enables an upgraded version of the platform to be inserted into the device.

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Application No:	GB 0027867.1	**Examiner:**	Dr E.P. Plummer
Claims searched:	all	**Date of search:**	16 January 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H1Q (QFK, QFS, QFU, QFX, QKC, QKE, QKL, QKN, QKX), H3Q (QAA, QACA)

Int Cl (Ed.7): H01Q (1/08, 1/10, 1/12, 1/22, 1/24, 1/42, 3/00, 3/02, 23/00), H04B

Other: INTERNET, ONLINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0936694 A2	(NORTHROP) see especially antenna 24 and circuitry 56, 58, 60 and 62 in figure 11 and lines 5 to 54 of column 9.	
A	US 5918163	(COMPAQ) see especially circuit components 302, 304 and 310 in figure 3A and 506, 508, 510, 512, 530 and 532 in figure 5.	
A	US 5557288	(IBM) see especially antenna 78 and circuit board 56 in figure 5.	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.